BIOSTATISTICS

Lecture 7 (Types of t-tests for quantitative data)

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REVISION

--- For qualitative data : we make chi-square.
---For quantitative data we make 4 types of t-test

1-one sample t-test
مثلا عندما يكون لدينا عينة واحدة نقارن وسطها الحسابي مع ال national figure .
2-independent sample t-test → اذا كان يوجد لدينا عينتان
3- ANOVA → اذا كان يوجد لدينا ثلاث عينات فأكثر
4-paired t-test
و هو الأكثر شيوعا و هو نفس الشخص قبل و بعد مثل مقارنة الفك العلوي مع السفلي أو الجانب الأيسر من الوجه مع الجانب الأيمن

1-one sample t-test:

If you know that the mean of blood sugar in Syrian population = 115 and you have a sample of Syrian students n=100, and its mean =110 , SD=4 , alpha=0.05 two sided. Is there any significal difference between the mean of the students and Syrian population?

$$T = \frac{(\bar{X} - \mu)}{\frac{S}{\sqrt{n}}} = (110-115) / (4/10) = -12.5$$

1)Ho→ no difference
2)HA→ the mean of Syrian students is less than the mean of the Syrian population.
3)Degree of freedom=n-1=100-1=99
4)Critical t value = 1.98 , alpha =0.05
5) T calculated > t critical
So, there is a significal difference (reject H0 and accept HA)
5) p-value = less than 0.001

normal distribution curve

مهم حفظ الارقام

2- Independent t-test:

عندما يكون هنالك عينتان نستخدم هذا الاختبار

If the Mean of The Total Population Is unknown:

So, we would choose two samples from the community and compare between the two-arithmetic means of these two samples, and here we have t-test for comparison between two sample means.

Example:

If we want to know whether English men are taller than Egyptian men?
In this case we choose two samples.
Sample1: 100 English men
Sample 2: 100 Egyptian men

Then measure the height of all men and calculate the arithmetic mean and standard deviation for each sample. Then do t-test for comparison between these two-arithmetic means.

Sample I: n_1 $\overline{X}_1$ S_1

Sample II: n_2 $\overline{X}_2$ S_2

Here we should calculate only one measure of dispersion estimated from the two samples and it is called pooled variance denoted (S^2_p).

$$t = \frac{(\overline{x_1} - \overline{x_2})}{\sqrt{\frac{s_p^2}{n_1} + \frac{s_p^2}{n_2}}} \quad \frac{1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}.$$

H_0: No difference between the heights of the two groups.

H_A: English men are taller than Egyptian men.

$n_1 = 100$, $\overline{X}_1 = 169$ cm	$S_1 = 12$ cm
$n_2 = 100$, $\overline{X}_2 = 165$ cm	$S_2 = 10$ cm

$$S^2p = \frac{S^2 1(n_1 - 1) + S^2 2(n_2 - 1)}{n_1 + n_2 - 2} = \frac{144 \times 99 + 100 \times 99}{100 + 100 - 2} = 122$$

$$t = \frac{\overline{x}_1 - \overline{x}_2}{\sqrt{\frac{S^2 p}{n_1} + \frac{S^2 p}{n_2}}} = \frac{169 - 165}{\sqrt{\frac{122}{100} + \frac{122}{100}}} = 2.5607$$

The critical value (t°) at 5% level of significance and d.f ($n_1 + n_2 - 2$) = 198 is 1.96.

Since 2.5607 > 1.96 we accept H_1, i.e.: English men are significantly taller than Egyptian men.

Example:

There are two groups distributed according there weight

$X_1 = 70$ $S_1 = 6$ $n_1 = 40$

$X_2 = 68$ $S_2 = 8$ $n_2 = 50$

Is there a significal difference between the two groups?

1) H_0 : no difference between the two groups
2) H_A : groups 2 weight is less than group 1 weights.

3) $S^2p = \frac{S^2 1(n_1 - 1) + S^2 2(n_2 - 1)}{n_1 + n_2 - 2}$ = (36 * 39 + 64 * 49) / 40+50-2 = 51.6

$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{S^2p}{n_1} + \frac{S^2p}{n_2}}}$ =(70-68) / ((51.6/40 + 51.6/50))^0.5 = 2 / (2.3) ^0.5 = **1.32**

4)degree of freedom= 50+40-2 = 88 → t critical= 1.98
t calculated < t critical → accept H_0 (no difference between the 2 groups)
5)p-value = more than 10%

Q1:Hemoglobine ratio in pregnant and non-pregnant women

X_1= 70 S_1= 4 n_1 = 40
X_2= 72 S_2= 6 n_2 = 113

Is there a significal difference in HB ratio ?

Q2:The IQ level in mut'ah 1 and china 2 medical student

X_1= 90 S_1= 10 n_1 = 70
X_2= 80 S_2= 2 n_2 = 30

Is there a significal difference ?

3-Dependent *t*-test for paired samples

(before-after , pre-post , upper-lower , left-right)

This test is used when the samples are dependent; that is, when there is only one sample that has been tested twice (repeated measures) or when there are two samples that have been matched or "paired". This is an example of a paired difference test.

$$t = \frac{\overline{X}_D - \mu_0}{s_D/\sqrt{n}}.$$

For this equation, the differences between all pairs must be calculated.
The pairs are either one person's pre-test and post-test scores or between pairs of persons matched into meaningful groups (for instance drawn from the same family or age group).
The average (X_D) and standard deviation (s_D) of those differences are used in the equation. The constant μ_0 is non-zero if you want to test whether the average of the difference is significantly different from μ_0.
The degree of freedom used is $n - 1$.

Example: fluoride varnish study

In ten at-risk children, fluoride varnish is applied in randomly assigned half-mouths. The remaining half-mouths are left untreated. The children are followed for two years and the new dmfs and locations are recorded:

patient	varnish	untreated	difference
1	2	3	-1
2	1	2	-1
3	0	1	-1
4	2	0	2
5	0	0	0
6	0	2	-2
7	2	5	-3
8	1	1	0
9	3	7	-4
10	5	4	1
mean	1.6	2.5	-0.90
sd			1.79

To perform the paired t-test, compute a one-sample t-test on the last column where H_0: $\mu = 0$.

$$T = \frac{-.90 - 0}{1.79/\sqrt{10}} = -1.59$$

For a two-tailed test compare $|-1.59| = 1.59$ to $t_{9, .975} = 2.262$. We do not reject since $1.59 < 2.262$. P-value is

$$P(|t_9| > |-1.59|) = 2 \times P(t_9 > 1.59) = 0.15.$$

Example:

1)H_0 : No difference between the two drugs

2)H_A :drug 2 is less affective than drug one

3)
Variance= (38- 4/9) / 9-1 = 4.7
SD= 4.7 ^ 0.5 = 2.17
SE= 2.17 / 3 = 0.72

XD = $X_{pre} - X_{post}$
OR SUM OF differences / n
XD = 0.222

$$t = \frac{\overline{X}_D - \mu_0}{s_D/\sqrt{n}}.$$

t=(0.222-0) / 0.72=0.308

4) degree of freedom = 8
→ t critical= 2.31 / alpha= 0.05

5) t calculated < t critical
so, we accept H_0 : No difference
6) p-value = more than 10%

Patient number	Pre	post	Difference	Difference^2
1	37	40	-3	9
2	38	39	-1	1
3	40	38	2	4
4	41	37	4	16
5	39	38	1	1
6	37	39	-2	4
7	36	37	-1	1
8	38	37	1	1
9	39	38	1	1
			SUM=2 XD= 2 /9 = 0.222	SUM=38
Mean	38.333	38.111	XD Pre-post 0.222	